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PN - JP7263280 A 19951013
 TI - CHIP-SHAPED LC COMPOSITE COMPONENT
 FI - H01F15/00&D ; H01G4/40&321A ; H03H7/075&A
 PA - MITSUBISHI MATERIALS CORP
 IN - KOJIMA YASUSHI
 AP - JP19940055406 19940325
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AN - 1995-387320 [51]
 TI - Composite LC element for noise filtering, suitable for surface mounting - has opposite ends of 3 earthing
 conductors connected to ground electrodes that are terminated intermediate main terminals NoAbstract
 IW - COMPOSITE LC ELEMENT NOISE FILTER SUIT SURFACE MOUNT OPPOSED END EARTH CONDUCTOR
 CONNECT GROUND ELECTRODE TERMINATE INTERMEDIATE MAIN TERMINAL NOABSTRACT
 AW - COMPOSITE INDUCTOR CAPACITOR MULTILAYER PRINTED COIL CHIP
 PN - JP7263280 A 19951013 DW199550 H01G4/40 005pp
 IC - H01F27/00 ; H01G4/40 ; H03H7/075
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 TI - CHIP-SHAPED LC COMPOSITE COMPONENT
 AB - PURPOSE:To obtain an LC composite component in which a strain and a crack due to a firing operation are not
 generated, whose characteristic is changed little and which is excellent in the removal of a noise.
 - CONSTITUTION:The starting end 23a and the termination end 25a of an inductor are exposed on both edges of
 a bare chip 41, and electrodes 42, 43 for signals are installed there. Ends 32a, 34a, 36a, on one side, of
 conductors for grounding are exposed on both of another edges of the bare chip, and electrodes 44, 45 are
 installed there. Conductors 23, 25 for an inductor are constituted in such a way that they are connected in
 series spirally in the thickness direction of the bare chip via through holes 13a, 14a formed in sheets so as to
 form the inductor. Individual conductors 32, 34, 36 for grounding are constituted in such a way that they are
 overlapped with the conductors for the inductor via sheets 12 to 15 so as to form a capacitor.
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 PA - MITSUBISHI MATERIALS CORP
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PATENT ABSTRACTS OF JAPAN

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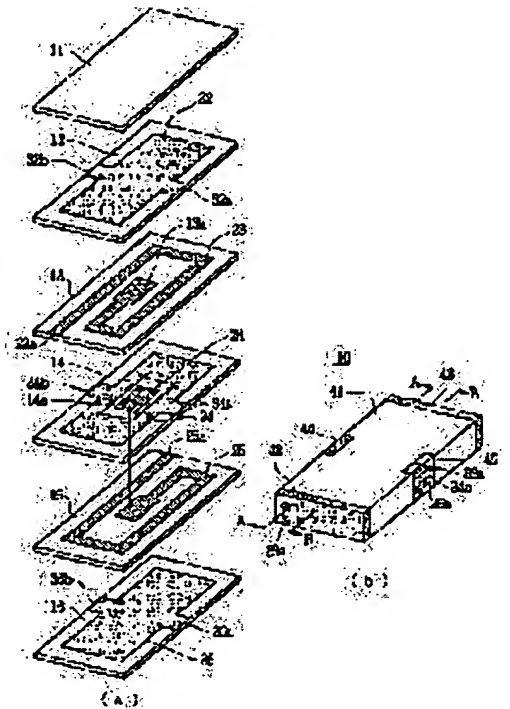
(72)Inventor : KOJIMA YASUSHI

(54) CHIP-SHAPED LC COMPOSITE COMPONENT

(57)Abstract:

PURPOSE: To obtain an LC composite component in which a strain and a crack due to a firing operation are not generated, whose characteristic is changed little and which is excellent in the removal of a noise.

CONSTITUTION: The starting end 23a and the termination end 25a of an inductor are exposed on both edges of a bare chip 41, and electrodes 42, 43 for signals are installed there. Ends 32a, 34a, 36a, on one side, of conductors for grounding are exposed on both of another edges of the bare chip, and electrodes 44, 45 are installed there. Conductors 23, 25 for an inductor are constituted in such a way that they are connected in series spirally in the thickness direction of the bare chip via through holes 13a, 14a formed in sheets so as to form the inductor. Individual conductors 32, 34, 36 for grounding are constituted in such a way that they are overlapped with the conductors for the inductor via sheets 12 to 15 so as to form a capacitor.



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CLAIMS

[Claim(s)]

[Claim 1] Magnetic-substance ferrite powder and dielectric ceramic powder it was made from the mixed predetermined compound ceramic ingredient which came out of comparatively -- many -- the green sheet (11-16) of several sheets -- the part (12-16) -- the object for inductors -- a conductor (23 25) and the object for a ground, after forming and carrying out a laminating so that a conductor (32, 34, 36) may be insulated electrically The bare chip (41) sintered by making this layered product into the shape of a chip is made into a subject. said object for inductors -- a conductor (23 25) by winding at least 1 ***** in the same flat surface inside said bare chip (41) It is constituted so that it may connect with a single string spirally and an inductor may be formed in the thickness direction of a bare chip (41) through the through hole (13a, 14a) formed in said sheet (13 14). The start edge (23a) is exposed to the 1st end face of said bare chip (41). And the termination (25a) is exposed to the 2nd end face of said bare chip (41). It is constituted. said object for a ground -- a conductor (32, 34, 36) -- the interior of said bare chip -- said sheet (12-15) -- minding -- said object for inductors -- a conductor (23 25) -- lapping -- said object for inductors -- so that a capacitor may be formed between conductors (23 25) And the both ends (32a, 32b, 34a, 34b, 36a, 36b) are exposed to the 3rd and 4th end faces of said bare chip (41). The electrode for the 1st and 2nd signals (42 43) electrically connected to the start edge (23a) and termination (25a) of a conductor, respectively is prepared in said 1st and 2nd end faces. the object for inductors exposed to the 1st and 2nd end faces of said bare chip (41) -- the object for a ground exposed to the 3rd and 4th end faces of said bare chip (41) -- that the electrode for the 1st and 2nd touch-down (44 45) connected electrically was prepared in the both ends (32a, 32b, 34a, 34b, 36a, 36b) of a conductor at said 3rd and 4th end faces Chip mold LC composite part by which it is characterized.

[Claim 2] In chip mold LC composite part according to claim 1 Magnetic-substance ferrite powder and dielectric ceramic powder it was made from the ceramic ingredient which replaces with the mixed predetermined compound ceramic ingredient which came out of comparatively, and consists only of dielectric ceramic powder -- many -- the green sheet (11-16) of several sheets -- the part (12-16) -- the object for inductors -- a conductor (23 25) and the object for a ground -- a conductor (32, 34, 36) Chip mold LC composite part which makes a subject the bare chip (41) sintered by making this layered product into the shape of a chip after forming and carrying out a laminating so that it may insulate electrically.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to LC composite part suitable for the noise rejection of electronic equipment. Furthermore, it is related with LC composite part of the chip mold which has both the functions of detailed capacitor ability [in which a surface mount is possible to a printed circuit board etc.] and detailed inductor ability.

[0002]

[Description of the Prior Art] Conventionally, the various proposals of the LC composite part which compounded the inductor and the capacitor and was made into monolithic structure are made. Carry out the printing laminating of the conductor by turns, and the layered product for capacitors is made. for example, these people -- the ceramic layer of a dielectric, and the object for capacitors -- Carry out the printing laminating of the conductor by turns, and the layered product for inductors is made. this layered product top for capacitors -- or this -- separate -- the ceramic layer of the magnetic substance, and the object for inductors -- Where these layered products for capacitors and the layered product for inductors are superimposed through an interlayer, it sintered in one, and LC composite part which prepared the suitable external terminal for the edge which the internal conductor exposed was proposed (for example, JP,3-166810,A). the object for inductors formed on the ceramic layer at the layered product for inductors of this LC composite part -- a spiral inductor is formed in the thickness direction of a layered product by connecting for every layer through the through hole which prepared the conductor in the ceramic layer.

[0003] Moreover, as another LC composite part, these people unified with adhesives the laminating chip inductor which prepared the internal electrode in the interior of a ferrite sintered compact, and the laminating chip capacitor which prepared the internal electrode and the ground electrode in the interior of a dielectric sintered compact, and did patent application of the pi mold LC filter which connected each external electrode of a laminating chip capacitor with the laminating chip inductor electrically mutually (Japanese Patent Application No. 5-112642).

[0004]

[Problem(s) to be Solved by the Invention] However, in LC composite part shown in JP,3-166810,A, since the rate of a heat shrink of the layered product for capacitors differed from the rate of a heat shrink of the layered product for inductors, thermal stress arose from the difference of this rate of a heat shrink at the time of baking, there were distortion by thermal stress, a crack, property fluctuation, etc. through an interlayer, and there was a fault inferior to the yield and dependability as a product. Moreover, while there was no above-mentioned fault, pi mold LC filter of Japanese Patent Application No. No. 112642 [five to] needed to sinter the laminating chip inductor and the laminating chip capacitor to each **, and its production control of a chip inductor and a chip capacitor was troublesome, and it had the fault which cannot miniaturize a product dimension easily, either.

[0005] The purpose of this invention is to stop thermal stress very small at the time of baking, and offer distortion, a crack, and little chip mold LC composite part of property fluctuation. Another purpose of this invention has the small stray capacity between the winding of the coil pattern which forms an inductor, and is to offer the chip mold LC composite part excellent in noise rejection. The surface mount to a printed circuit board etc. is possible for still more nearly another purpose of this invention, it is small, and is to offer the high chip mold LC composite part of productivity.

[0006]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the configuration of this invention is

explained using drawing 1 corresponding to an example. the chip mold LC composite part 10 of this invention was made from the predetermined compound ceramic ingredient which came out comparatively and was mixed in magnetic-substance ferrite powder and dielectric ceramic powder -- many -- the green sheets 11-16 of several sheets -- those parts 12-16 -- the object for inductors -- conductors 23 and 25 and the object for a ground -- let the bare chip 41 sintered by making this layered product into the shape of a chip be a subject after forming and carrying out a laminating so that conductors 32, 34, and 36 may be insulated electrically. the object for inductors -- by winding at least 1 ***** in the same flat surface of the bare chip 41 interior, it is constituted so that it may connect with a single string spirally and an inductor may be formed in the thickness direction of a bare chip 41 through the through holes 13a and 14a formed in sheets 13 and 14, and the start edge 23a is exposed to the 1st end face of a bare chip 41, and the termination 25a exposes conductors 23 and 25 to the 2nd end face of a bare chip 41. the object for a ground -- conductors 32, 34, and 36 -- the interior of a bare chip -- sheets 12-15 -- winding -- the object for inductors -- conductors 23 and 25 -- lapping -- the object for inductors -- it is constituted so that a capacitor may be formed among conductors 23 and 25, and the both ends 32a, 32b, 34a, 34b, 36a, and 36b are exposed to the 3rd and 4th end faces of a bare chip 41. the object for inductors exposed to the 1st and 2nd end faces of a bare chip 41 -- the electrodes 42 and 43 for the 1st and 2nd signals electrically connected to start edge 23a and termination 25a of a conductor, respectively are formed in the 1st and 2nd end faces. the object for a ground exposed to the 3rd and 4th end faces of a bare chip 41 -- the electrodes 44 and 45 for the 1st and 2nd touch-down connected electrically are formed in the both ends 32a, 32b, 34a, 34b, 36a, and 36b of a conductor at the 3rd and 4th end faces. In addition, it sets to the above-mentioned chip mold LC composite part. Magnetic-substance ferrite powder and dielectric ceramic powder it was made from the ceramic ingredient which replaces with the mixed predetermined compound ceramic ingredient which came out of comparatively, and consists only of dielectric ceramic powder -- many -- the green sheets 11-16 of several sheets -- the parts 12-16 -- the object for inductors -- conductors 23 and 25 and the object for a ground -- conductors 32, 34, and 36 After forming and carrying out a laminating so that it may insulate electrically, it is good also considering the bare chip 41 sintered by making this layered product into the shape of a chip as a subject.

[0007]

[Function] Since an inductor and a capacitor are constituted using the green sheets 12-16 made from the same ceramic ingredient, the simplification of a process can be achieved, the thermal stress at the time of baking can be stopped very small, and troubles, such as distortion and a crack, can be avoided to a bare chip 41. moreover, the object for inductors -- the inside of the same flat surface as conductors 23 and 35 -- adjoining -- or the object for inductors -- conductors 23 and 25 -- up and down -- adjoining -- respectively -- the object for a ground, in order to arrange conductors 32, 34, and 36 these objects for inductors -- the inductor formed with conductors 23 and 25 -- generating of stray capacity -- very -- few -- moreover -- the object for inductors -- conductors 23 and 25 and each object for a ground, in order to form a capacitor among conductors 32, 34, and 36 It can use for the noise rejection of a broad frequency.

[0008]

[Example] Next, the example of this invention is explained in detail based on a drawing. LC composite part of this example uses as a start raw material the compound ceramic ingredient which predetermined came out comparatively and mixed magnetic-substance ferrite powder and dielectric ceramic powder -- many -- the laminating of the green sheet of several sheets is carried out, this layered product is made into the shape of a chip, and it sinters, and is made. This compound ceramic ingredient is a compound functional material having fixed permeability and a fixed dielectric constant. In this example, as magnetic-substance ferrite powder, after carrying out weighing capacity of each powder of NiO, ZnO, CuO, and Fe₂O₃ so that predetermined may become comparatively, wet blending of it was carried out. After calcinating mixture at 1000 degrees C for 2 hours, wet-mill grinding was carried out and the magnetic-substance ferrite powder whose mean particle diameter is about 0.1 micrometers was prepared. This presentation was nickel_{0.24}Zn_{0.22}Cu_{0.06}Fe_{0.96}O_{1.96}. Moreover, as dielectric ceramic powder, after carrying out weighing capacity of each powder of PbO, La₂O₃, and ZrO₂ and TiO₂ so that predetermined may become comparatively, wet blending of it was carried out. After calcinating mixture at 1150 degrees C for 2 hours, wet-mill grinding was carried out and the dielectric ceramic powder whose mean particle diameter is about 0.1 micrometers was prepared. This presentation was Pb_{0.88}La_{0.12}Zr_{0.7}Ti_{0.3}O_{3.06}.

[0009] If the magnetic-substance ferrite powder and dielectric ceramic powder which were prepared are mixed by the weight ratio of 60:40, sintering temperature will be acquired for the compound ceramic ingredient around 1030 degrees C. In addition, as for the mixing ratio of this magnetic-substance ferrite powder and dielectric ceramic powder, it is

desirable to select from the range of 60-40:40-60 suitably. Moreover, in order to suppress the reaction between the ingredients of the magnetic-substance ferrite powder at the time of baking, and dielectric ceramic powder and to reduce burning temperature, it is desirable to add amelioration material. It is CdO-ZnO-B₂O₃ as for example, a presentation system, and this amelioration material calcinates CdO, ZnO, and B₂O₃ at 900 degrees C for 1 hour, after being mixed by the mole ratio of 1:1:1, it is obtained by carrying out mill grinding, and is fine particles whose mean particle diameter is about 0.1 micrometers. In this example, amelioration material was mixed with magnetic-substance ferrite powder and dielectric ceramic powder by the weight ratio of 60:40:1.5, and sintering temperature obtained the compound ceramic ingredient around 950 degrees C. Next, mill mixing is carried out with the binder and binder solvent which can gasify the obtained compound ceramic ingredient at the time of baking, a slurry is prepared, and this slurry is fabricated to a green sheet by the doctor blade method. In addition, this sheet can knead a compound ceramic ingredient, a binder, and the solvent for binders, can make them a paste, and can also make this paste by print processes.

[0010] Thus, several multi-sheet laminating of the obtained green sheet is carried out. the front face of some green sheets -- a conductive paste -- screen printing -- applying -- the object for inductors -- a conductor and the object for a ground -- it is formed so that a conductor may insulate electrically. the object for the inductors of a green sheet -- a through hole is opened in the interconnect location of a conductor, and a predetermined number-of-sheets laminating is carried out, filling up a through hole with a conductive paste as occasion demands. After pressing of the obtained layered product is carried out, it is cut in the shape of a chip, is calcinated, and serves as a bare chip.

[0011] As shown in drawing 1 (a), in order to simplify explanation here, the example which carried out the laminating of the green sheets 11-16 of six sheets is given. Nothing is printed by the green sheet 11 of the 1st sheet, and a conductor is not formed. the front face of the green sheets 13 and 15 of the 3rd sheet and the 5th sheet -- the object for inductors -- conductors 23 and 25 form -- having -- the center of the front face of the green sheet 14 of the 4th sheet -- the object for inductors -- the object for the connection for connecting conductors 23 and 25 electrically -- a conductor 24 is formed. the green sheets 12, 14, and 16 of the 2nd more sheet, the 4th sheet, and the 6th sheet -- the object for a ground -- conductors 32, 34, and 36 are formed.

[0012] the object for the inductors of the green sheet 13 of the 3rd sheet -- the object for the inductors of a lower layer [edge / of a conductor 23] -- through hole 13a for connecting with a conductor is opened. the object for connection of the green sheet 14 of the 4th sheet -- through hole 14a is opened in the edge of a conductor 24. these through hole 13a and 14a2 objects for inductors -- when the laminating of the conductors 23 and 25 is carried out, it connects with a single string spirally and they form an inductor in the thickness direction. the object for the inductors of the green sheet 13 of the 3rd sheet -- end 23a of a conductor 23 is prolonged to the edge of a green sheet 13 as the start edge of an inductor. the object for the inductors of the green sheet 15 of the 5th sheet -- end 25a of a conductor 25 is prolonged to another edge of a green sheet 15 as termination of an inductor.

[0013] the object for a ground formed in the green sheet 14 of the 4th sheet -- the object for connection by which the conductor 34 was formed in the center -- spacing electrically insulated with a conductor 24 is opened, it is formed, and end 34a and other end 34b are prolonged to two side edges which a green sheet 14 counters, respectively. the object for a ground formed in the green sheets 12 and 16 of the 2nd sheet and the 6th sheet -- conductors 32 and 36 -- the object for inductors -- it is constituted so that it may lap with conductors 23 and 25, and it extends to two side edges which the Ends 32a and 36a and other ends 32b and 36b counter.

[0014] If the laminating of these green sheets 11-16 is carried out and they are calcinated, the bare chip 41 which the rectangular parallelepiped sintered will be obtained. the object for inductors which serves as the start edge of an inductor at the 1st end face of this bare chip 41 as shown in drawing 1 (b), drawing 2, and drawing 3 -- the object for inductors which serves as termination of an inductor although end 23a of a conductor 23 is exposed and not being illustrated to the 2nd end face -- end 25a of a conductor 25 is exposed. the same -- the 3rd and 4th end faces of a bare chip 41 -- the object for a ground -- Ends 32a, 34a, and 36a and the other ends 32b, 34b, and 36b of conductors 32, 34, and 36 are exposed. By applying and baking a conductive paste on the 1st and 2nd end faces, the electrodes 42 and 43 for signals are formed, and the electrodes 44 and 45 for touch-down are similarly formed in the 3rd and 4th end faces. Thereby, the LC composite part 10 is obtained. two objects for inductors -- conductors 23 and 25 are connected to a single string through through holes 13a and 14a inside a bare chip 41 -- having -- an inductor -- forming -- three objects for a ground -- conductors 32, 34, and 36 -- sheets 12-15 -- minding -- the object for inductors -- conductors 23 and 25 -- lapping -- these objects for inductors -- a capacitor is formed between conductors. This equal circuit is shown in

drawing 4 .

[0015] In addition, the presentation of the magnetic-substance ferrite powder shown in the above-mentioned example may be an example, and may be one sort or a thing included two or more sorts about nickel, Zn, Cu, Mn, Mg, Co, etc. Moreover, the thing of not only a lead system but a barium titanate system may be used also for the presentation of dielectric ceramic powder.

[0016]

[Effect of the Invention] Since an inductor and a capacitor are constituted using the green sheet made from the same ceramic ingredient according to this invention as stated above, the simplification of a process can be achieved, the thermal stress at the time of baking can be stopped very small, troubles, such as distortion and a crack, can be avoided to a bare chip, and there is also little property fluctuation. moreover, the object for inductors -- a conductor -- up and down -- adjoining -- respectively -- the object for a ground -- in order to arrange a conductor -- these objects for inductors -- the inductor formed with the conductor -- generating of stray capacity -- very -- few -- moreover -- the object for inductors -- a conductor and each object for a ground -- since a capacitor is formed between conductors, it can use for the noise rejection of a broad frequency. By using the ingredient which has the property of not only a dielectric but the magnetic substance especially, sufficient inductance is acquirable, it is highly efficient and the small noise filter in which a surface mount is possible can be realized to a printed circuit board etc.

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TECHNICAL FIELD

[Industrial Application] This invention relates to LC composite part suitable for the noise rejection of electronic equipment. Furthermore, it is related with LC composite part of the chip mold which has both the functions of detailed capacitor ability [in which a surface mount is possible to a printed circuit board etc.] and detailed inductor ability.

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PRIOR ART

[Description of the Prior Art] Conventionally, the various proposals of the LC composite part which compounded the inductor and the capacitor and was made into monolithic structure are made. for example, these people -- the ceramic layer of a dielectric, and the object for capacitors -- carry out the printing laminating of the conductor by turns the layered product for capacitors -- making -- this layered product top for capacitors -- or this -- separate -- the ceramic layer of the magnetic substance, and the object for inductors -- the printing laminating of the conductor was carried out by turns, and the layered product for inductors was made, where these layered products for capacitors and the layered product for inductors are superimposed through an interlayer, it sintered in one, and LC composite part which prepared the suitable external terminal for the edge which the internal conductor exposed was proposed (for example, JP,3-166810,A). the object for inductors formed on the ceramic layer at the layered product for inductors of this LC composite part -- a spiral inductor is formed in the thickness direction of a layered product by connecting for every layer through the through hole which prepared the conductor in the ceramic layer.

[0003] Moreover, as another LC composite part, these people unified with adhesives the laminating chip inductor which prepared the internal electrode in the interior of a ferrite sintered compact, and the laminating chip capacitor which prepared the internal electrode and the ground electrode in the interior of a dielectric sintered compact, and did patent application of the pi mold LC filter which connected each external electrode of a laminating chip capacitor with the laminating chip inductor electrically mutually (Japanese Patent Application No. 5-112642).

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EFFECT OF THE INVENTION

[Effect of the Invention] Since an inductor and a capacitor are constituted using the green sheet made from the same ceramic ingredient according to this invention as stated above, the simplification of a process can be achieved, the thermal stress at the time of baking can be stopped very small, troubles, such as distortion and a crack, can be avoided to a bare chip, and there is also little property fluctuation. moreover, the object for inductors -- a conductor -- up and down -- adjoining -- respectively -- the object for a ground -- in order to arrange a conductor -- these objects for inductors -- the inductor formed with the conductor -- generating of stray capacity -- very -- few -- moreover -- the object for inductors -- a conductor and each object for a ground -- since a capacitor is formed between conductors, it can use for the noise rejection of a broad frequency. By using the ingredient which has the property of not only a dielectric but the magnetic substance especially, sufficient inductance is acquirable, it is highly efficient and the small noise filter in which a surface mount is possible can be realized to a printed circuit board etc.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in LC composite part shown in JP,3-166810,A, since the rate of a heat shrink of the layered product for capacitors differed from the rate of a heat shrink of the layered product for inductors, thermal stress arose from the difference of this rate of a heat shrink at the time of baking, there were distortion by thermal stress, a crack, property fluctuation, etc. through an interlayer, and there was a fault inferior to the yield and dependability as a product. Moreover, while there was no above-mentioned fault, pi mold LC filter of Japanese Patent Application No. No. 112642 [five to] needed to sinter the laminating chip inductor and the laminating chip capacitor to each **, and its production control of a chip inductor and a chip capacitor was troublesome, and it had the fault which cannot miniaturize a product dimension easily, either.

[0005] The purpose of this invention is to stop thermal stress very small at the time of baking, and offer distortion, a crack, and little chip mold LC composite part of property fluctuation. Another purpose of this invention has the small stray capacity between the winding of the coil pattern which forms an inductor, and is to offer the chip mold LC composite part excellent in noise rejection. The surface mount to a printed circuit board etc. is possible for still more nearly another purpose of this invention, it is small, and is to offer the high chip mold LC composite part of productivity.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the configuration of this invention is explained using drawing 1 corresponding to an example. the chip mold LC composite part 10 of this invention was made from the predetermined compound ceramic ingredient which came out comparatively and was mixed in magnetic-substance ferrite powder and dielectric ceramic powder -- many -- the green sheets 11-16 of several sheets -- those parts 12-16 -- the object for inductors -- conductors 23 and 25 and the object for a ground -- let the bare chip 41 sintered by making this layered product into the shape of a chip be a subject after forming and carrying out a laminating so that conductors 32 , 34 , and 36 may be insulated electrically . the object for inductors -- by winding at least 1 ***** in the same flat surface of the bare chip 41 interior, it is constituted so that it may connect with a single string spirally and an inductor may be formed in the thickness direction of a bare chip 41 through the through holes 13a and 14a formed in sheets 13 and 14, and the start edge 23a is exposed to the 1st end face of a bare chip 41, and the termination 25a exposes conductors 23 and 25 to the 2nd end face of a bare chip 41. the object for a ground -- conductors 32, 34, and 36 -- the interior of a bare chip -- sheets 12-15 -- minding -- the object for inductors -- conductors 23 and 25 -- lapping -- the object for inductors -- it is constituted so that a capacitor may be formed among conductors 23 and 25, and the both ends 32a, 32b, 34a, 34b, 36a, and 36b are exposed to the 3rd and 4th end faces of a bare chip 41. the object for inductors exposed to the 1st and 2nd end faces of a bare chip 41 -- the electrodes 42 and 43 for the 1st and 2nd signals electrically connected to start edge 23a and termination 25a of a conductor, respectively are formed in the 1st and 2nd end faces. the object for a ground exposed to the 3rd and 4th end faces of a bare chip 41 -- the electrodes 44 and 45 for the 1st and 2nd touch-down connected electrically are formed in the both ends 32a, 32b, 34a, 34b, 36a, and 36b of a conductor at the 3rd and 4th end faces. In addition, it sets to the above-mentioned chip mold LC composite part. Magnetic-substance ferrite powder and dielectric ceramic powder it was made from the ceramic ingredient which replaces with the mixed predetermined compound ceramic ingredient which came out of comparatively, and consists only of dielectric ceramic powder -- many -- the green sheets 11-16 of several sheets -- the parts 12-16 -- the object for inductors -- conductors 23 and 25 and the object for a ground -- conductors 32, 34, and 36 After forming and carrying out a laminating so that it may insulate electrically, it is good also considering the bare chip 41 sintered by making this layered product into the shape of a chip as a subject.

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OPERATION

[Function] Since an inductor and a capacitor are constituted using the green sheets 12-16 made from the same ceramic ingredient, the simplification of a process can be achieved, the thermal stress at the time of baking can be stopped very small, and troubles, such as distortion and a crack, can be avoided to a bare chip 41. moreover, the object for inductors -- the inside of the same flat surface as conductors 23 and 35 -- adjoining -- or the object for inductors -- conductors 23 and 25 -- up and down -- adjoining -- respectively -- the object for a ground -- in order to arrange conductors 32, 34, and 36, these objects for inductors -- the inductor formed with conductors 23 and 25 -- generating of stray capacity -- very -- few -- moreover -- the object for inductors -- conductors 23 and 25 and each object for a ground -- since a capacitor is formed among conductors 32, 34, and 36, it can use for the noise rejection of a broad frequency.

[Translation done.]

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EXAMPLE

[Example] Next, the example of this invention is explained in detail based on a drawing. LC composite part of this example uses as a start raw material the compound ceramic ingredient which predetermined came out comparatively and mixed magnetic-substance ferrite powder and dielectric ceramic powder -- many -- the laminating of the green sheet of several sheets is carried out, this layered product is made into the shape of a chip, and it sinters, and is made. This compound ceramic ingredient is a compound functional material having fixed permeability and a fixed dielectric constant. In this example, as magnetic-substance ferrite powder, after carrying out weighing capacity of each powder of NiO, ZnO, CuO, and Fe₂O₃ so that predetermined may become comparatively, wet blending of it was carried out. After calcinating mixture at 1000 degrees C for 2 hours, wet-mill grinding was carried out and the magnetic-substance ferrite powder whose mean particle diameter is about 0.1 micrometers was prepared. This presentation was $\text{nickel}_{0.24}\text{Zn}_{0.22}\text{Cu}_{0.06}\text{Fe}_{0.96}\text{O}_{1.96}$. Moreover, as dielectric ceramic powder, after carrying out weighing capacity of each powder of PbO, La₂O₃, and ZrO₂ and TiO₂ so that predetermined may become comparatively, wet blending of it was carried out. After calcinating mixture at 1150 degrees C for 2 hours, wet-mill grinding was carried out and the dielectric ceramic powder whose mean particle diameter is about 0.1 micrometers was prepared. This presentation was $\text{Pb}_{0.88}\text{La}_{0.12}\text{Zr}_{0.7}\text{Ti}_{0.3}\text{O}_{3.06}$.

[0009] If the magnetic-substance ferrite powder and dielectric ceramic powder which were prepared are mixed by the weight ratio of 60:40, sintering temperature will be acquired for the compound ceramic ingredient around 1030 degrees C. In addition, as for the mixing ratio of this magnetic-substance ferrite powder and dielectric ceramic powder, it is desirable to select from the range of 60-40:40-60 suitably. Moreover, in order to suppress the reaction between the ingredients of the magnetic-substance ferrite powder at the time of baking, and dielectric ceramic powder and to reduce burning temperature, it is desirable to add amelioration material. It is CdO-ZnO-B₂O₃ as for example, a presentation system, and this amelioration material calcinates CdO, ZnO, and B₂O₃ at 900 degrees C for 1 hour, after being mixed by the mole ratio of 1:1:1, it is obtained by carrying out mill grinding, and is fine particles whose mean particle diameter is about 0.1 micrometers. In this example, amelioration material was mixed with magnetic-substance ferrite powder and dielectric ceramic powder by the weight ratio of 60:40:1.5, and sintering temperature obtained the compound ceramic ingredient around 950 degrees C. Next, mill mixing is carried out with the binder and binder solvent which can gasify the obtained compound ceramic ingredient at the time of baking, a slurry is prepared, and this slurry is fabricated to a green sheet by the doctor blade method. In addition, this sheet can knead a compound ceramic ingredient, a binder, and the solvent for binders, can make them a paste, and can also make this paste by print processes.

[0010] Thus, several multi-sheet laminating of the obtained green sheet is carried out. the front face of some green sheets -- a conductive paste -- screen printing -- applying -- the object for inductors -- a conductor and the object for a ground -- it is formed so that a conductor may insulate electrically. the object for the inductors of a green sheet -- a through hole is opened in the interconnect location of a conductor, and a predetermined number-of-sheets laminating is carried out, filling up a through hole with a conductive paste as occasion demands. After pressing of the obtained layered product is carried out, it is cut in the shape of a chip, is calcinated, and serves as a bare chip.

[0011] As shown in drawing 1 (a), in order to simplify explanation here, the example which carried out the laminating of the green sheets 11-16 of six sheets is given. Nothing is printed by the green sheet 11 of the 1st sheet, and a conductor is not formed. the front face of the green sheets 13 and 15 of the 3rd sheet and the 5th sheet -- the object for inductors -- conductors 23 and 25 form -- having -- the center of the front face of the green sheet 14 of the 4th sheet --

the object for inductors -- the object for the connection for connecting conductors 23 and 25 electrically -- a conductor 24 is formed. the green sheets 12, 14, and 16 of the 2nd more sheet, the 4th sheet, and the 6th sheet -- the object for a ground -- conductors 32, 34, and 36 are formed.

[0012] the object for the inductors of the green sheet 13 of the 3rd sheet -- the object for the inductors of a lower layer [edge / of a conductor 23] -- through hole 13a for connecting with a conductor is opened. the object for connection of the green sheet 14 of the 4th sheet -- through hole 14a is opened in the edge of a conductor 24. these through hole 13a and 14a2 objects for inductors -- when the laminating of the conductors 23 and 25 is carried out, it connects with a single string spirally and they form an inductor in the thickness direction. the object for the inductors of the green sheet 13 of the 3rd sheet -- end 23a of a conductor 23 is prolonged to the edge of a green sheet 13 as the start edge of an inductor. the object for the inductors of the green sheet 15 of the 5th sheet -- end 25a of a conductor 25 is prolonged to another edge of a green sheet 15 as termination of an inductor.

[0013] the object for a ground formed in the green sheet 14 of the 4th sheet -- the object for connection by which the conductor 34 was formed in the center -- spacing electrically insulated with a conductor 24 is opened, it is formed, and end 34a and other end 34b are prolonged to two side edges which a green sheet 14 counters, respectively. the object for a ground formed in the green sheets 12 and 16 of the 2nd sheet and the 6th sheet -- conductors 32 and 36 -- the object for inductors -- it is constituted so that it may lap with conductors 23 and 25, and it extends to two side edges which the Ends 32a and 36a and other ends 32b and 36b counter.

[0014] If the laminating of these green sheets 11-16 is carried out and they are calcinated, the bare chip 41 which the rectangular parallelepiped sintered will be obtained. the object for inductors which serves as the start edge of an inductor at the 1st end face of this bare chip 41 as shown in drawing 1 (b), drawing 2, and drawing 3 -- the object for inductors which serves as termination of an inductor although end 23a of a conductor 23 is exposed and not being illustrated to the 2nd end face -- end 25a of a conductor 25 is exposed. the same -- the 3rd and 4th end faces of a bare chip 41 -- the object for a ground -- Ends 32a, 34a, and 36a and the other ends 32b, 34b, and 36b of conductors 32, 34, and 36 are exposed. By applying and baking a conductive paste on the 1st and 2nd end faces, the electrodes 42 and 43 for signals are formed, and the electrodes 44 and 45 for touch-down are similarly formed in the 3rd and 4th end faces. Thereby, the LC composite part 10 is obtained. two objects for inductors -- conductors 23 and 25 are connected to a single string through through holes 13a and 14a inside a bare chip 41 -- having -- an inductor -- forming -- three objects for a ground -- conductors 32, 34, and 36 -- sheets 12-15 -- minding -- the object for inductors -- conductors 23 and 25 - lapping -- these objects for inductors -- a capacitor is formed between conductors. This equal circuit is shown in drawing 4.

[0015] In addition, the presentation of the magnetic-substance ferrite powder shown in the above-mentioned example may be an example, and may be one sort or a thing included two or more sorts about nickel, Zn, Cu, Mn, Mg, Co, etc. Moreover, the thing of not only a lead system but a barium titanate system may be used also for the presentation of dielectric ceramic powder.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] (a) is the perspective view of the green sheet in front of the laminating of LC composite part of this invention. (b) is the perspective view of the LC composite part.

[Drawing 2] The A-A line sectional view of drawing 1 (b).

[Drawing 3] The B-B line sectional view of drawing 1 (b).

[Drawing 4] The representative circuit schematic.

[Description of Notations]

10 LC Composite Part

11-16 Green sheet

13a, 14a Through hole

23 and 25 the object for inductors -- conductor

23a The start edge of an inductor

24 Object for Connection -- Conductor

25a Termination of an inductor

32, 34, and 36 the object for a ground -- conductor

32a, 34a, and 36a the object for a ground -- end of a conductor

32b, 34b, and 36b the object for a ground -- the other end of a conductor

41 Bare Chip

42 43 Electrode for signals

44 45 Electrode for touch-down

[Translation done.]